Perspective

Cost concerns for robotic thoracic surgery

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In an era of increasing scrutiny of expenditure on healthcare, the cost of technological developments such as robotic surgery is an important consideration. Prior studies have shown that robotic thoracic procedures can be performed safely with perioperative results that are comparable to thoracotomy and VATS approaches (1-3). Whether this technology adds benefit at a cost that is reasonable is an unanswered question. Given the high capital and maintenance costs of these systems, it is necessary to analyze their cost to the healthcare system. Assessing the cost and value of robotic surgery is, however, a complex undertaking.

In attempting to elucidate the cost implications of robotic technology, one strategy would be to perform a cost comparison between robotic, VATS and thoracotomy procedures. This approach has been demonstrated in a recent retrospective study comparing VATS and thoracotomy for lobectomy (4). In this study, thoracotomy was on average $700 more per procedure in terms of hospital cost, despite the fact that operating room (OR) time was lower than with VATS. The likely difference was due to shorter hospital stay and complications in the VATS cohort. A similar study was performed for robotic, VATS and thoracotomy for lobectomy (5). Even without taking into consideration the indirect and amortized costs, robotic surgery adds additional direct OR costs compared with conventional VATS or thoracotomy.

There are two main sources of disposable costs at the time of the procedure. The first is the cost of the drapes, valued at approximately $200 USD. The second is the cost of the instruments. This varies depending on how many and what type of instruments are employed. On average each instrument used for a procedure costs $200 USD, with the expense of instruments ranging from at least $400 to $1,000 USD. The total additional disposable cost of employing robotics is therefore between $600 and $1,200. In the case of robotics compared with thoracotomy, however, this added OR cost did not result in greater overall cost of the entire hospital stay. We have previously shown that the average cost of robotic lobectomy was more expensive than VATS, yet substantially less expensive than thoracotomy.

Unlike the VATS study, this observation was made taking into account two additional costs of robotics that are more difficult to calculate in a consistent manner. The first is the direct OR cost, i.e. the cost associated with increased time associated with system setup and increased operative time. While there is no doubt that early in the development of robotic procedures this component adds substantial increased cost, it is also likely that with continued refinement in technique and experience of both surgeon and OR team, this will be minimized. Moreover, the difference between different surgeons and centers is difficult to ascertain. The second is the amortized cost of the robotic system. This is calculated by the following formula: (total capital cost of the system + total service costs over the life of the system)/total number of cases performed with the system. At best the amortized cost is an estimate based on a large number of assumptions: duration of use of a particular system, total service costs, total capital costs and total number of cases performed with a given system. It is inaccurate to assign a fixed additional amortized cost to each robotic procedure.

For example, in our previous analysis the amortized cost of each case was calculated by adding the following: the initial purchase cost, the service costs (assuming a 10-year life span of the system) and dividing by an estimate of the total number of cases performed. In order to determine the latter, the actual number of cases performed with the system was added to the projected additional number of cases for the remainder of the 10-year life span of the system assuming utilization at a fixed level from the most recent year. However, soon after the study the institution acquired 3 new systems, returning the original system and receiving credit. Should this be subtracted from the capital cost of the original or from the subsequent systems? If from the subsequent systems, should it be applied to the cost of a single system or to all of the new systems? Does this now mean that the actual cases performed with the original system are now more or less costly?

Perhaps the best method to evaluate the cost implications of any technology for thoracic surgical procedures is a formal cost effectiveness analysis. This has not been done for VATS technology. For a cost analysis between robotics, VATS and thoracotomy one would have to assume that the three approaches are equivalent in clinical efficacy. This may be problematic given that there is no level I evidence showing that any minimally invasive approaches are equivalent to conventional thoracotomy. Outcome data for robotic lobectomy are only beginning to emerge and are largely drawn from single arm retrospective experiences (6). While VATS lobectomy series are greater in number, the majority are retrospective, with few cohort studies comparing VATs to thoracotomy. The few cohort studies that do exist focus largely on perioperative outcome (7-9), showing an advantage for VATS, but there has been recent evidence that suggests that for the surgical treatment and staging of early stage lung cancer, a VATS approach may be associated with a lower rate of accurate hilar lymph node assessment compared with thoracotomy (10).

Moreover, there are two areas of potential cost benefit not likely to be included in cost analyses of robotic technology. The first is the impact of robotics on the volume of cases in general and for a particular institution. What is the cost benefit if a patient decides to pursue surgical therapy at a particular hospital based on the availability of a minimally invasive robotic approach? Second, what is the cost benefit of robotics if it allows wider implementation of a potentially more cost effective alternative, i.e. minimally invasive lung resection instead of thoracotomy? A recent analysis of the voluntary Society of Thoracic Surgery (STS) database demonstrated that, while the percentage of all lobectomies performed by VATS has been increasing, the overall percentage of cases performed by VATS during the 3-year study period ending in 2006 was only 20%. Furthermore, another recent analysis of a non-voluntary national insurance database indicated that <6% of lobectomies were performed via VATS. The fact remains that the majority of major lung resections performed in the United States are still via thoracotomy. If robotic technology can result in a more widespread adoption of a minimally invasive approach in a safe and appropriate manner that has not been achieved with VATS, the added cost may be justified by all the potential benefits over traditional open surgery. This point also addresses the issue of the cost benefit of robotic technology to those patients who are able to undergo minimally invasive surgery instead of thoracotomy. It is important to take into account the cost benefit to the patient of faster recovery, quicker return to preoperative activity level such as return to work, as well as less expenditure for management of postoperative complications and outpatient services like visiting nurse and rehabilitation.

The capital cost of robotic surgical systems, particularly as there is currently only a single supplier, is significant. This cost must be evaluated critically because of the implications on healthcare expenditures in general. However, the financial impact of robotics is no less significant than other seemingly less costly technological innovations that are implemented without the same attention to cost or efficacy that surgical robotics receives. It is incumbent upon all healthcare practitioners to critically evaluate the costs and benefits of any new technology in order to determine the appropriate utilization of our limited healthcare resources.

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